INSTRUCTIONS

GEH-2758B
Supersedes GEH-2758A
and GEH-2775

V-60 SERIES
POLYPHASE WATTHOUR METERS

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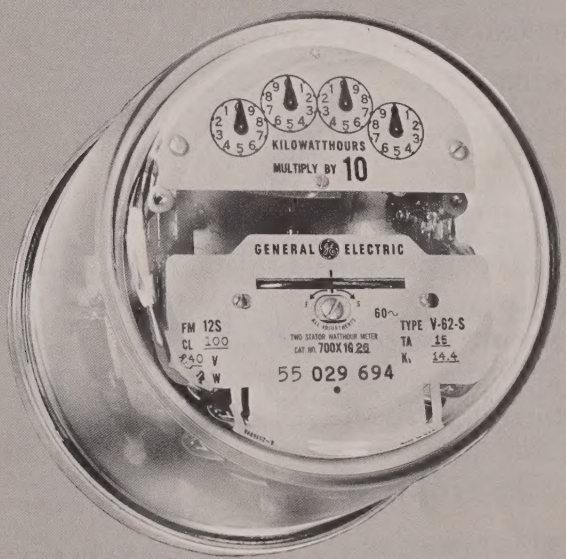
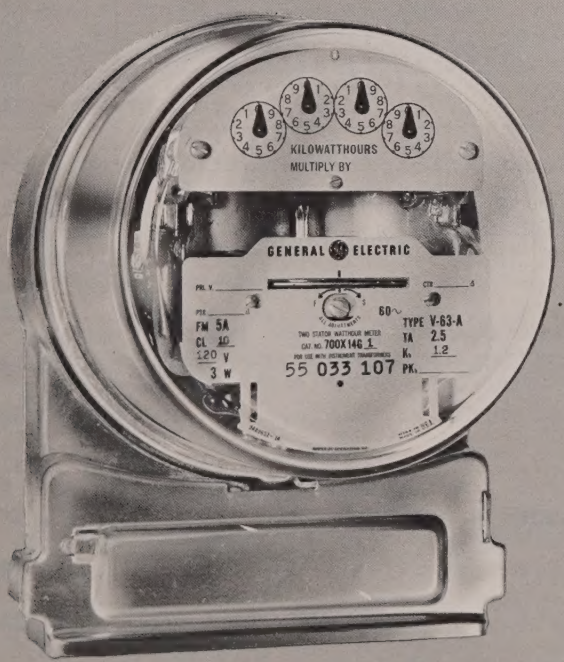


Type V-62-S
Socket-connected



Type V-63-A
Bottom-connected

MP MASTER
MA32672

GENERAL ELECTRIC

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NOTICE OF CHANGES:

This issue of GEH-2758B is a complete revision of the previous issue of GEH-2758A.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. The equipment covered by these operating instructions should be operated and serviced only by competent technicians familiar with good safety practices, and these instructions are written for such personnel and are not intended as a substitute for adequate training and experience in safe procedures for this type of equipment. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

V-60 SERIES
POLYPHASE WATTHOUR METERS

INTRODUCTION

These instructions apply to General Electric two- and three-stator polyphase meters of the following types:

TYPE METER		CIRCUIT APPLICATION
Socket-connected	Bottom-connected	
Two-stator:		
V-62-S	V-62-A	3-wire network 3-wire; 1-, 2-, or 3-phase
V-63-S	V-63-A	3-wire; 1-, 2-, or 3-phase
V-65-S	V-65-A	4-wire Y; 3-phase
V-66-S	V-66-A	4-wire delta; 3-phase
Three-stator:		
V-64-S	V-64-A	4-wire Y; 3-phase

The letter "M" in the type designation denotes a watthour demand meter with mechanical demand register (Type M-60, M-30, M-31, or M-51); for example: Type VM-62-S.

Similarly, the letter "W" in the type designation denotes a watthour meter with demand contact device (Type D-20, D-30, D-41, or D-51), for example: Type VW-62-A.

INSTALLATION

All meters are factory-calibrated before shipment.

The meter should be installed plumb and in a location that is free from heavy vibration.

The glass cover can be sealed independently before mounting the meter for service, if desired. Refer to SEALING THE METER, page 4.

The following procedure should be observed when installing meters.

SOCKET-CONNECTED "S" CONSTRUCTION METERS

1. Make sure that the meter socket is mounted securely in place and in such a position that the rotor shaft will be vertical when the meter is mounted.

> **CAUTION:** *THE METER SOCKET USED MUST BE COMPATIBLE WITH THE CIRCUIT AND WITH THE METER USED. REFER TO SELECTION GUIDE GET-3120 FOR CORRECT MATCHING OF METER AND SOCKET. ALSO, SEE CONNECTION DIAGRAMS IN THIS BOOK.*

2. In order to ground the meter frame, and surge protectors (if present), good contact between ground straps and socket rim should be ensured by scraping off paint, if any, from the socket rim at the points where these straps make contact.

3. Make connections to the socket terminals as shown in the appropriate diagram included in this book. For connections of contact devices and impulse generators, refer to the instruction book covering the particular type of demand meter being operated by the contact device.

4. Plug the meter into the socket, with the meter cover sealed separately, if desired. Make sure that the meter terminal blades properly engage with the socket jaws. In order to ensure connection of the meter to its load circuit before line potential is applied, always insert the meter load (bottom) terminal blades into the socket jaws first; when removing, withdraw them last.

5. Push the meter into place so that the base fits tightly against the socket rim. If a sealing ring is used, place it around the adjoining meter cover and socket rim. Position it so that the clamp is at the bottom of the meter, then tighten in place. If the sealing ring is marked to identify one side as "FRONT," be sure it is installed accordingly.

6. Seal the latch or clamping screw of the sealing ring or the cover latch of the ringless socket.

BOTTOM-CONNECTED "A" CONSTRUCTION METERS

These meters have mounting and terminal chamber dimensions which conform to industry standards, and can therefore be used with all standard meter mountings intended for use with bottom-connected multi-stator meters.

If used without a mount, proceed as follows:

1. Locate, and insert in the mounting surface, the top supporting screw. Use a round-head screw not smaller than No. 12 American Standard.

2. A reversible meter hanger is attached to the back of the base by a single screw. Adjust this hanger to the desired position and hang the meter by inserting the head of the supporting screw through the larger part of the keyhole opening in the hanger. (See also step 5 below.)

3. Remove the terminal cover.

4. Holes are provided in the lower corners of the base for insertion of the two bottom supporting screws. Level the meter by eye, insert the two lower screws, and tighten. Use round-head screws not smaller than No. 12 American Standard.

5. It is recommended that the meter base be grounded, in order to make the surge-relief gaps (if present) effective in self-contained 120- and 240-volt meters, and for reasons of safety in all meters used with instrument transformers. This can be done by using the hanger on the back of the meter in the external position, i.e., with the top mounting screw exposed, and then securing the ground wire terminal between the head of this screw and the meter hanger. This connection, using No. 12 AWG copper wire, should be completed before external connections to the meter are made.

6. Make connections to the meter as shown in the appropriate diagram included in this book. (For connections of contact devices or impulse generators, refer to the instruction book covering the particular type of demand meter being operated by the device.) The connections should be made by working from right to left. This assures connection of the meter to its load circuit before the line potential is applied. Disconnection of the meter should be made in the reverse order. The terminal holes for current leads will accept No. 2 (0.292-inch diameter) stranded wire. Use thimble adapters, Cat. No. 4124628G3 (package of eight adapters), for larger wire sizes.

SEALING THE METER

"S" CONSTRUCTION METERS

The glass cover is held to the meter base by three spring clips which engage with lugs on the molded base. When the cover is tightened by being turned clockwise until seated against the stops, the seal holes in the cover ring will line up opposite the seal pocket in the molded base. A "break-off" type sealing tab or a lead wire seal may be used.

CAUTION: *IF A LEAD WIRE SEAL IS USED, AFTER CRIMPING THE SEAL BE SURE TO CUT OFF THE EXCESS WIRE TO PREVENT POSSIBLE SHORTING WITH SOCKET TERMINALS WHEN THE METER IS MOUNTED.*

"A" CONSTRUCTION METERS

The glass cover is held to the meter base by three bayonet-type spring clips located inside the cover ring, which engage with lugs on the die-cast base. When the cover is tightened by being turned clockwise until seated firmly, the cover seal bar located on the right-hand top surface of the terminal chamber can be slid to the left, where it engages a lug on the cover ring. When locked in this position by a seal through the slot on the right-hand side of the terminal chamber, it prevents removal of the glass cover.

The terminal cover can also be sealed and, when in place, prevents removal of the glass cover, so that the entire meter can be protected by the single seal. The standard gasketless terminal cover is held in place by the insertion of the seal in the slot provided. Terminal covers with gaskets are also available. These are held in place by two screws which are covered, after tightening, by a sliding seal bar.

INSTRUMENT TRANSFORMERS

Both current and potential transformers have polarity markings of white paint, or markers H_1 for primary and X_1 for secondary, located on or near one primary and one secondary terminal. These markings denote relative polarity of the windings and indicate that the instantaneous direction of currents in the leads is the same; namely, toward the transformer in the marked primary lead, and from the transformer in the secondary lead, or vice versa. The polarity markings are shown in the connection diagrams and, in order to obtain correct direction of rotation of the watthour meters, must be followed regardless of their physical location on the transformers.

The bases of meters used with current and potential transformers, or with current transformers only, should be connected to the grounded side of the secondary circuit of such transformers. No. 12 AWG copper wire is suitable for this purpose. At the earth end of the wire the usual precautions employed in connection with lightning arresters should be followed.

CAUTION: *UNDER NO CONDITIONS SHOULD THE CURRENT CIRCUIT OF A TRANSFORMER-RATED METER BE OPENED WITHOUT FIRST SHORT-CIRCUITING THE SECONDARY WINDING OF THE CURRENT TRANSFORMER.*

READING THE REGISTER

The 4-dial registers used on self-contained meters of the lower capacities read in kilowatt-hours directly. Registers used on the higher-capacity meters may have 5 dials and read directly, or may have 4 dials and require a dial-face multiplier (register constant), by which the register reading must be multiplied in order to obtain kilowatt-hours. This multiplier is usually 10 or 100 and is shown on the register face or nameplate.

Transformer-rated meters are furnished with either "secondary-reading" or "primary-reading" registers.

"Secondary-reading" registers have high ratios to read the energy in the transformer secondary circuit. Consequently,

1. The actual reading of these registers must be multiplied by the proper constant, which is the ratio of primary energy to secondary energy, in order to obtain kilowatt-hours in the primary circuit being metered. This constant is normally the product of the respective ratios of the current and potential transformers used with the meter.

2. Meters with such registers can be used with transformers of any ratio without changing registers, since only the multiplier is affected.

"Primary-reading" registers have ratios (usually low) to read the energy in the transformer primary circuit; i.e., they allow for the potential and current transformer ratios. Consequently,

1. Multipliers can be conveniently in tens; i.e., 1, 10, 100, 1000 or higher.

2. Changing transformer ratios usually requires changing register ratio.

The watthour constant (K_h) marked on the nameplate is for use only in calibrating and checking the meter, and must not be used in connection with the register reading.

When reading the pointer-type register, the position of each pointer must be determined accurately. In deciding upon the reading of each pointer, the pointer before it (to the right) must be observed. Unless this pointer has reached or passed zero or, in other words, completed a revolution, the pointer to its left has not completed the division upon which it may appear to rest. For this reason, the register can be read most easily and rapidly from right to left.

The demand registers may be either the sweep-hand, cumulative, or dial type. Refer to the applicable demand-register instructions (see list on page 14) for reading these registers.

FIGURING REGISTER RATIOS

The register ratio "R_r" is defined as the number of revolutions of the worm gear which meshes with the rotor shaft, required to produce one revolution of the fastest (right-hand) pointer.

For example, if the register is direct-reading, i.e., having a multiplier of 1, then one revolution of the fastest pointer equals 10 kilowatt-hours. Now determine how many disk revolutions equal 10 kilowatt-hours, thus:

Disk revolutions for one kilwatt-hour =

$$\frac{1000 \text{ (watthours per kilowatt-hour)}}{K_h \text{ (watthours per disk revolution)}}$$

Disk revolutions for 10 kilowatt-hours =

$$10 \times \frac{1000}{K_h}$$

K_h is the watthour constant which appears on the meter nameplate, and is the watthours recorded for one revolution of the rotor disk.

For example, calculate the register ratio for a 15-ampere, 120-volt, V-62 meter. This meter has a K_h of 7.2 watthours per disk revolution. Therefore,

Disk revolutions for 10 kilowatt-hours =

$$10 \times \frac{1000}{7.2} = 1388\ 8/9$$

To get the register worm-gear revolutions for 10 kilowatt-hours, divide this figure by the gear reduction between the rotor shaft and the worm gear. This reduction is the number of teeth on the worm gear (100) divided by the pitch of the worm on the rotor shaft (2). Therefore, the first gear reduction is $\frac{100}{2} = 50$. Dividing the disk revolutions for 10 kilowatt-hours by 50 gives

Worm-gear revolutions for 10 kilowatt-hours =

$$\frac{1388\ 8/9}{50} = 27\ 7/9$$

Since this is the worm-gear revolutions for one revolution of the first pointer, it is by definition the register ratio, R_r.

Consolidating the above steps,

$$R_r = \frac{10 \times \frac{1000}{K_h}}{\frac{100}{2}} = \frac{10{,}000}{50\ K_h} = \frac{200}{K_h}$$

As another example, consider a 30-ampere, 240-volt, V-62 meter with $K_h = 28.8$:

$$R_r = \frac{200}{28.8} = 6\ \frac{17}{18}$$

However, a 4-dial register with this low ratio might turn over completely between monthly readings, if the meter were operated continuously at heavy load, so normal practice would call for either a 5-dial direct-reading register, $R_r = 6\ 17/18$, or a 4-dial register with a multiplier (register constant) of 10, in which case the register ratio would be

$$R_r = 10 \times 6\ 17/18 = 69\ 4/9$$

The general formula for the register ratio, including dial-face multiplier, is therefore

$R_r = \frac{200}{K_h}$ x dial-face multiplier, for self-contained V-60 series meters.

For further information on register ratios, refer to publication GET-1887.

TESTING

Instructions for testing and adjusting General Electric a-c watthour meters are given in publication GET-813.

The portable watthour-meter standards manufactured by the General Electric Company provide means for making the necessary field tests quickly and accurately and independent of load variations. For testing in the meter shop, the GE photoelectric meter tester provides both improved accuracy and savings in time. Details can be obtained by applying to the General Electric Company.

For using the photoelectric tester to test meters with demand registers, refer to DEMAND REGISTERS section, page 11.

WATTHOUR CONSTANT

The watthour constant "K_h" marked on the nameplate is the number of watthours per revolution of the meter rotor. On the nameplate of transformer-rated meters, however, two watthour constants are shown; namely, "Test K" or "K_h" for use when testing the meter without transformers, and the "Primary Test K" or "Primary K_h" as the over-all constant for the meter with its transformers.

To improve performance over the extended current and voltage ranges, rotor speed of the V-60 series meters has been reduced to *one-half* that of corresponding V-series meters. This results in a watthour constant (K_h) twice that previously applicable to a given rating of meter. However, in order that register ratios be consistent with those already in use, a *double-pitch worm* is used on the rotor shaft so that, for the same rating of meter, the register ratio is unchanged from that used on the V-series of meters.

CALIBRATING ADJUSTMENTS

The following adjustments are provided for calibrating the meters for all load conditions met in normal service. All adjustments act to increase the meter speed when turned counterclockwise, and decrease the speed when turned clockwise, as indicated on the nameplate around the full-load adjustment screw. (See Figs. 1 and 2.)

FULL LOAD

Full-load adjustment is made by turning the micrometer screw shown in Figs. 1 and 2. This screw has sufficient range for all normal requirements, including adjustment of a replacement magnet, should this ever be necessary. This adjustment affects the meter calibration equally at all loads and power factors. One turn of the screw will change the calibration approximately 0.3 to 0.4 percent.

CAUTION: *DURING THE ADJUSTMENT, CLEANING, OR REPLACEMENT OF A RETARDING MAGNET, IT IS IMPORTANT NOT TO ALLOW ANY MAGNETIC OBJECT, SUCH AS A SCREWDRIVER BLADE OR MAGNETIC GAP CLEANER, TO COME INTO CONTACT WITH THE MAGNET POLE FACES BECAUSE IT WILL POSSIBLY WEAKEN THE MAGNET.*

LIGHT LOAD

Light-load adjustment is made by moving the light-load plate sidewise, to the right or left, in the air gap of each stator with the adjusting screws provided (Figs. 1 and 2). Since this adjustment introduces a fixed torque of a magnitude depending on the amount the plate is moved, the effect varies inversely with the load torque. For example, a 5-percent change at 1/10 rated load current will cause approximately 0.5 percent change in the same direction at rated load 1.0 power factor, and approximately 1.0 percent change at rated load 0.5 power factor. The direction of adjustment is the

same as for full load, i.e., counterclockwise to increase speed.

For the Type V-64 meters, the light-load adjustment is furnished on the left and right stators only, none being necessary on the rear stator. On 10-percent series load, the sensitivity is about 0.5 percent per turn of both screws. For all other Type V-60 meters, sensitivity of this adjustment is about 0.7 percent per turn when testing one stator at 20 percent rated load, or 1.4 percent per turn when both stators are working at 10 percent load, and both adjusting screws are turned.

> **NOTE:** *If the meter under test has a contact device, the light-load check should cover sufficient revolutions (4 to 6) of the disk to average out variation in friction due to contact position.*

INDUCTIVE LOAD (Power Factor)

For Type V-64 meters, inductive-load (power-factor) adjustment is made by turning three micrometer resistance adjusting screws located at the bottom of the meter (see Fig. 2). The sensitivity is roughly 0.3 percent per turn on the average, depending somewhat on the position of the adjustment. The adjustment is not linear.

For all other Type V-60 meters, inductive-load adjustment is made by moving the lag plate radially with respect to the disk, into or out of the air gap on each stator with the adjusting screw provided. See Fig. 1. The sensitivity is approximately 0.5 percent per turn.

The direction of adjustment is the same as for full load, i.e., counterclockwise to increase speed. Whenever the inductive-load adjustment is changed, both full-load and light-load calibrations should be checked, as they may be affected a small amount.

TORQUE BALANCE (Phase Balance)

For Type V-64 meters, torque-balance (phase-balance) adjustment is made by turning a single flux-shunting screw in both the left and right stators (see Fig. 2). The sensitivity is about one percent per turn. On the rear stator the torque is factory-adjusted.

For all other Type V-60 meters, the two stators in each meter have their torques equalized at the factory by means of the two steel adjusting screws located in the shunt potential flux gaps of each stator. These appear just above the supporting bracket for the lag and light-load plates and are readily accessible from the sides of the meter. (See Fig. 1.)

Should it be necessary to make any change in this adjustment, as may be the case when installing a new stator, the two screws of each stator should always be moved exactly the same number of turns and in the same direction. This will prevent excessive shift in light-load calibration. Turning the screws counterclockwise increases the torque (speed) of the stator. Sensitivity is about 0.75 percent per turn of the two screws. After balancing the torques of the stators, the accuracy of the meter should be checked on full load, inductive load and light load.

REGISTER DRIVE FOR V-64 METERS

The register drive assembly (see Fig. 2) consists of two vertical shafts, one of which carries an idler gear which meshes with the 20-tooth pinion on the rotor shaft, and also meshes with and drives a similar 20-tooth pinion on the second, or driven, shaft. This driven shaft thus rotates at the same speed and in the same direction as the rotor shaft, and serves to drive all the registers used with this meter. For pointer-type registers and Types M-30, M-31, and M-51 demand registers, a double-pitch worm is cut into the driven shaft. The 20-tooth pinion on the driven shaft is also used to drive the Type M-60 demand register, when used. The driven shaft in the register drive is furnished with a hobbed 8-tooth pinion for use in driving a contact device.

> **NOTE:** *The gear and bearings in the register drive should never, under any circumstances, be oiled. They are designed to last indefinitely without lubrication at a low friction level.*

The adjustment on the register drive is for the purpose of setting the mesh between the idler gear and the rotor-shaft pinion only, and *should not* be used to adjust mesh of the register. (This is done in the normal way by using the adjustment on the register.) For this reason, the adjusting screw on the register drive is not slotted. When it is necessary to adjust the mesh of the idler gear with the rotor-shaft pinion, this should be done with the register removed, and is accomplished by turning the adjusting screw clockwise to deepen the mesh or counterclockwise to lighten the mesh, until the correct mesh (1/2 tooth depth) is obtained. The adjustment is locked by spring tension.

MAINTENANCE

MAGNETIC SUSPENSION SYSTEM

No maintenance of the magnetically suspended rotor in the V-60 series meters should be required in normal service during the life of the meter. No lubrication is required nor should any be used.

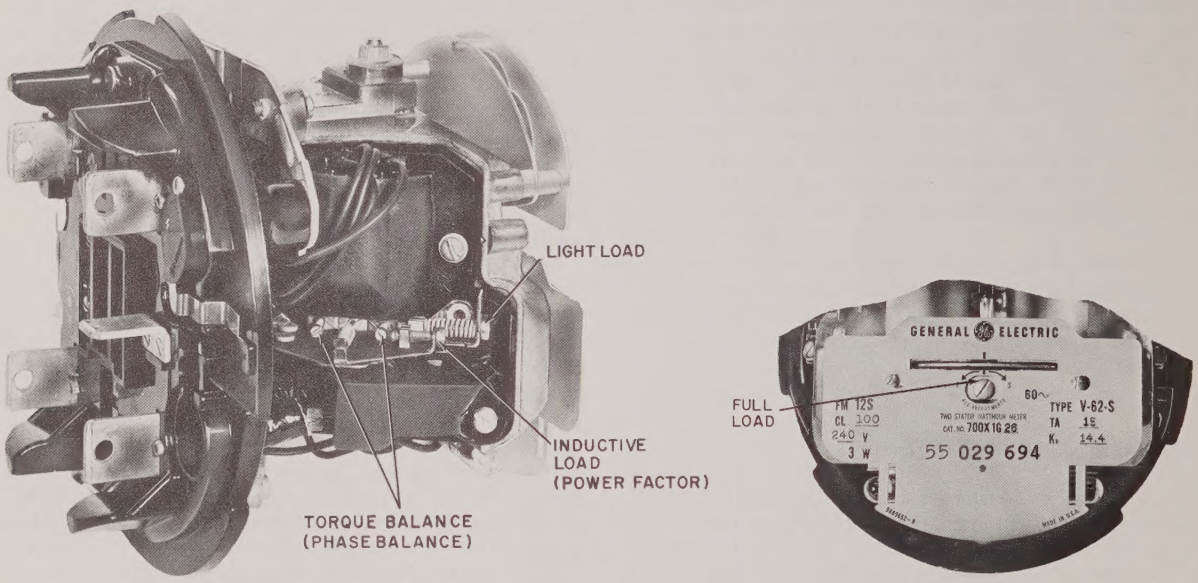


Fig. 1. Location of adjustments on V-60 series 2-stator meters

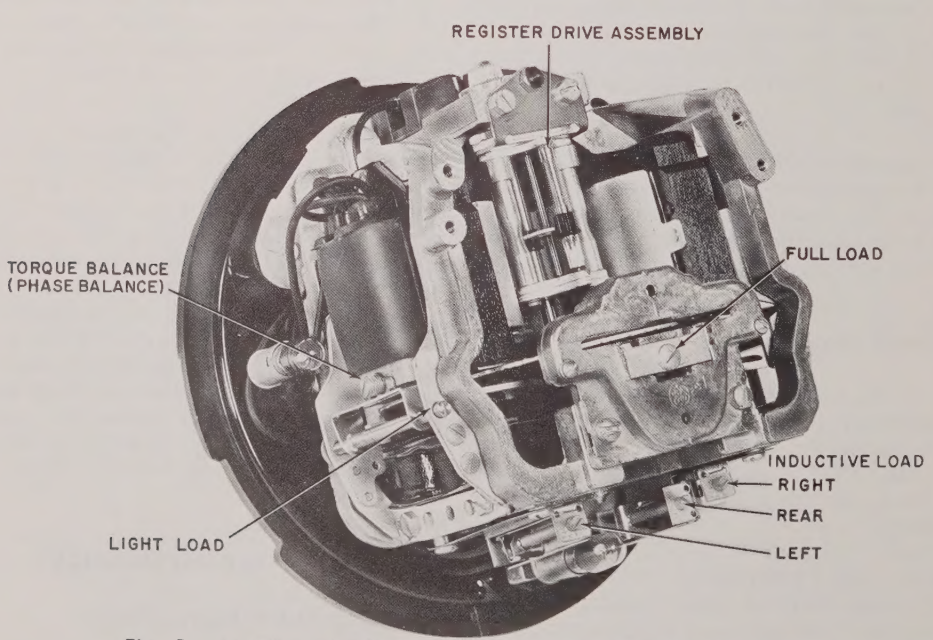


Fig. 2. Location of adjustments on Type V-64-S 3-stator meters

Inspection

With the meter in normal operating position, inspection can be made as follows (see Fig. 3):

1. Raise the rotor until movement is stopped by the centering pin. In this position, the disk should have clearance below the upper pole faces of the retarding magnet. The clearance can be adjusted by moving the outer suspension assembly.

2. Depress the rotor until movement is stopped by the lower guide pin. The disk should move downward 0.005 inch to 0.010 inch and have clearance above the lower pole faces of the retarding magnet. This downward motion and clearance can be adjusted by moving the lower guide assembly.

Removal of Suspension

If it becomes necessary to remove the suspension system, it can be done in the following manner:

1. Remove the register, nameplate, and retarding magnet. On Type V-64 meters, also remove the register drive assembly (see Fig. 2).

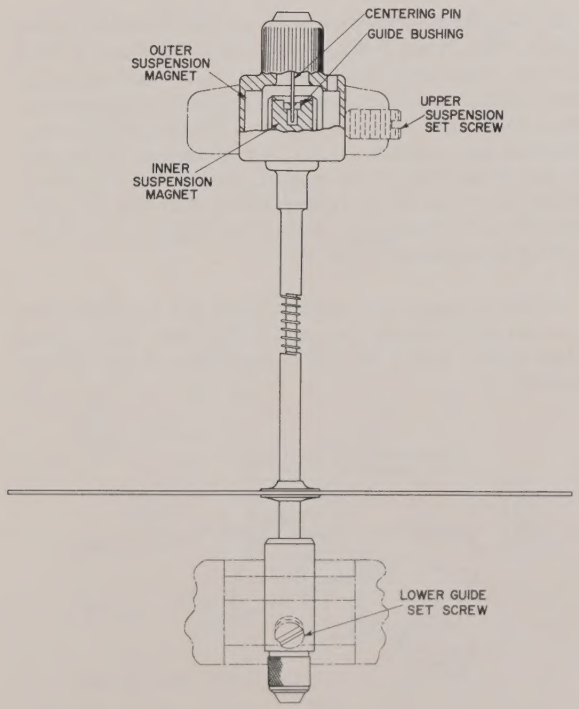


Fig. 3. Magnetic suspension system

CAUTION: *IN REMOVING THE RETARDING MAGNET, IT IS IMPORTANT NOT TO ALLOW ANY MAGNETIC OBJECT, SUCH AS A SCREWDRIVER BLADE OR MAGNETIC GAP CLEANER, TO COME INTO CONTACT WITH THE MAGNET POLE FACES BECAUSE IT WILL POSSIBLY WEAKEN THE MAGNET. ALSO, KEEP THE MAGNET AWAY FROM MAGNETIC PARTICLES.*

2. Loosen the lower guide setscrew and remove the lower guide.

3. Loosen the upper suspension setscrew and remove the outer suspension assembly.

NOTE: *The outer suspension assembly contains the outer magnet and centering pin. Necessary precautions should be observed in handling to prevent demagnetization of the magnet or damage to the centering pin. Magnetic objects should not touch the magnet. Cleanliness is essential when handling this assembly. Keep it away from magnetic particles.*

4. Remove the rotor. The die-cast section at the top of the shaft contains the inner magnet, so take precautions as described in the Note under step 3 above.

Assembly of Suspension

Assemble the suspension system as follows:

1. Place the meter in the operating position.

2. Inspect the inner magnet for any dirt or magnetic particles. (Use a non-magnetic tool to clean, if necessary.) Insert the rotor into the die-cast frame.

3. Inspect the outer suspension assembly for any dirt or magnetic particles. (Use a non-magnetic tool to clean, if necessary.) Assemble the assembly into the hole at the top of the die-cast frame and enter the rotor into the assembly. The centering pin will be guided into the hole in the bushing by the countersink.

4. Finger-tighten the upper suspension setscrew.

5. Inspect the lower guide for any dirt. Insert it into the hole at the bottom of the die-cast frame and enter the centering pin into the bushing in the bottom of the shaft.

6. Finger-tighten the lower guide setscrew.

7. Assemble the retarding magnet. On V-64 meters, assemble the register drive assembly before adding the magnet.

8. Center the disk in the retarding-magnet air gap by moving the outer suspension assembly. Tighten the upper suspension setscrew.

9. Move the lower guide upward until motion of the disk is noted. Then move the lower guide downward 0.005 inch to 0.010 inch. Tighten the lower guide setscrew.

10. Check the position of the disk in the magnet gap. Refer to the INSPECTION section on page 9.

11. Replace the register and nameplate.

REGISTER

The register dial face can be cleaned by the use of a cloth moistened slightly with water.

When replacing a register, be sure the new register has the same register ratio and multiplier. Carefully inspect the mesh of its worm gear with the worm on the rotor shaft to see that it is approximately 1/3 to 2/3 the depth of tooth on the register worm gear. If it is not, a means for adjustment is provided in the eccentric adjusting screw in the bracket on the back of the register. Avoid meshing too deeply, which might cause friction and affect the accuracy of the meter.

The use of oil on the bearings of the register is not recommended.

For proper care of demand registers, refer to their respective instructions. See publication list on page 14.

SURGE PROTECTORS

Self-contained meters with serial numbers 51, 075, 000 and above, Types V-62-S, V-64-S, V-65-S and V-66-S meters, rated 120 and 240 volts, have external surge protectors assembled to the meter base. Two protectors are used on the V-62-S, while the V-64-S, V-65-S and V-66-S have three each (as shown in Fig. 4).

The surge protector provides protection for the meter against high voltage surges caused by lightning discharges. Its design permits 20 or more operations before replacement is necessary. The surge protector can be inspected by first removing it from the meter base, then taking off the cap, which is held in place by one screw. When installing a new protector, no adjustment is necessary.

Meters with surge protectors can be used on any distribution system regardless of the maximum current capacity of the system. This is possible because the surge protector is designed to limit the follow current, thus providing proper operation under all conditions.

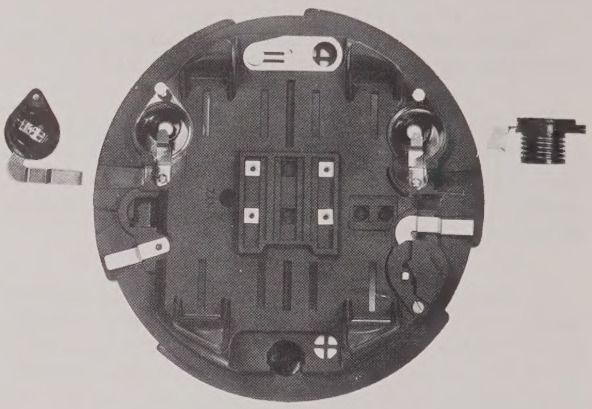


Fig. 4. V-60 polyphase meter base with two of the three surge protectors removed from the base

Surge protectors are not designed for use on 480- and 600-volt meters.

For detailed information on the surge protector, see GE publication GEA-9057.

SURGE RELIEF GAPS

Self-contained meters with serial numbers below 51, 075, 000, Types V-62-S, V-63-S, V-65-S and V-66-S meters, rated 120 and 240 volts, have built-in surge relief systems incorporating controlled air gaps between incoming lines and ground. These are factory-adjusted and require no further attention, other than proper grounding of the meter. However, if a meter stator is replaced, it is important that the air gaps have proper clearance. Refer to Figs. 5 and 6 for correct gap dimensions.

Bottom-connected meters rated 120 and 240 volts, with serial numbers below 50, 891, 090, have surge relief gaps. Refer to Fig. 7 for correct gap dimensions.

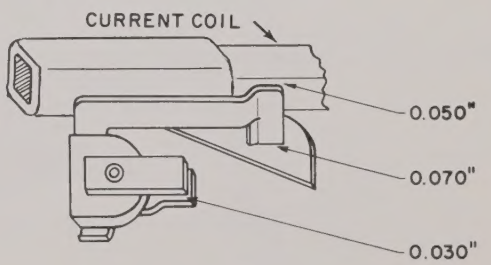


Fig. 5. Surge relief gaps on Types V-62-S and V-63-S meters

NOTE: *If distribution-system fault currents at the meter can exceed 2500 amperes RMS, then external valve-type lightning protection should be provided.*

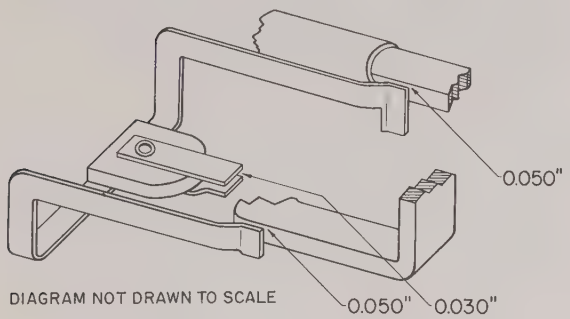
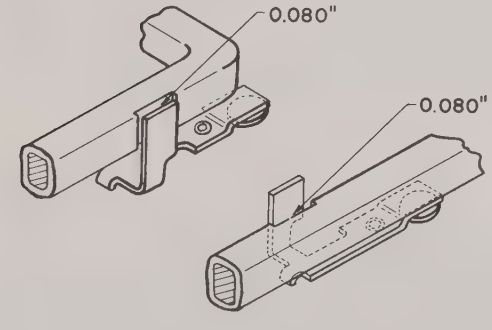
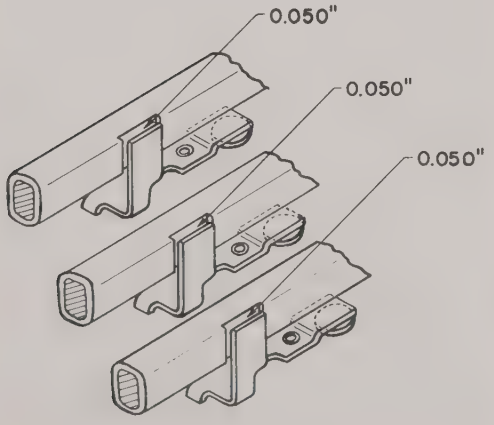


Fig. 6. Surge relief gaps on Types V-65-S (120-volt) and V-66-S meters



(a) Type V-62-A



(b) Types V-63-A, V-65-A and V-66-A

Fig. 7. Surge relief gaps on A-type meters

If an "S" base assembly is ordered from the factory for replacement on meters with surge relief gaps, the new base will be furnished with surge protectors rather than relief gaps. Accompanying each supply base is a kit containing leads, screws and a connection diagram. No adjustment is necessary on these protectors.

STATOR

If a potential or current coil is damaged, the entire stator should be replaced.

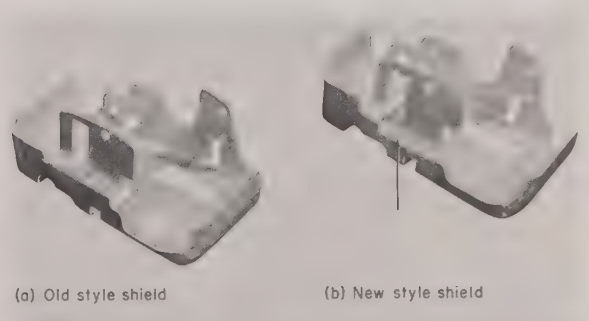
DEMAND REGISTERS

Refer to separate instructions for proper care and installation of demand registers. See publication list on page 14.

NOTE: *Types M-30, M-31, and M-51 demand registers require a motor shield when used on meters having magnetic suspension. Before installing demand registers with serial numbers below 1653204 on V-60 series meters, it is necessary to remove the motor shield and replace it with a later-design shield. This change in the shield design (see arrow in Fig. 8) eliminates mechanical interference between the register and the meter.*

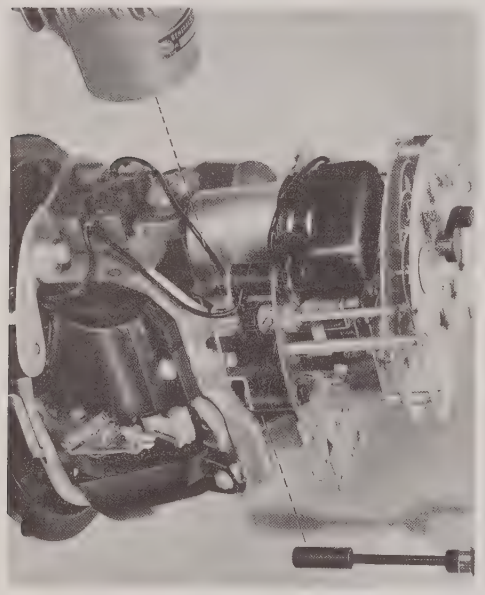
When using the photoelectric tester for testing meters having the Type M-60 demand register, the photocell unit may be used on either side of the meter, although the left side is easier. (See Fig. 9a.) The glass cover may be left on the meter. Proceed as follows:

1. Arrange the light source so that it shines through the disk hole.

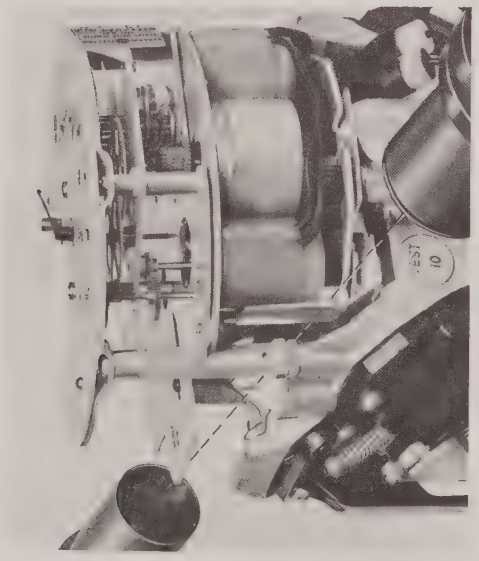


(a) Old style shield (b) New style shield

Fig. 8. Motor shield for Types M-30, M-31, and M-51 demand registers



(a) Meter with Type M-60 register



(b) Meter with Type M-30, M-31, or M-51 register

Fig. 9. Recommended position of photoelectric tester when testing meters which have demand registers

2. Place a hand or piece of paper under the disk to locate the light source. Move the tester probe under the disk and into the light beam.

3. Check to ensure proper operation of the tester.

In using the photoelectric tester to test meters with Types M-30, M-31, and M-51 demand registers, some difficulty may be encountered in finding a light path through the register and disk. This can be done by aiming the light source at a slight angle to the vertical, and passing the light beam downward by the rear end of the right-hand motor field coil, either through the hole provided in the motor shield at this point, or entirely back of the shield. This is demonstrated in Fig. 9b.

A more convenient and flexible method of obtaining a triggering impulse from the disk is to use a high-sensitivity, cadmium-selenide photocell assembly. This assembly operates from the reflected light on the disk surface, with triggering occurring when the light beam is interrupted by the long black mark printed on the disk.

CONTACT DEVICES

Contact devices and impulse generators for VW-60 series meters are mounted on the front of the meter frame, just below the register. A separate pair of mounting holes is provided for this purpose. See Fig. 10. The spur drive gear on the contact device or impulse generator meshes with a spur pinion hobbed into the rotor shaft.

Fig. 10. Type D-30-V contact device mounted on a Type VW-63-A polyphase meter

Four types of contact devices may be used on VW-60 series meters:

1. D-20-V 2-wire, low impulse rate.
2. D-30-V 3-wire, low impulse rate.
3. D-41 3-wire impulse generator (with auxiliary amplifier) with very high impulse rate.
4. D-51 3-wire impulse generator, with very high impulse rate.

CAUTION: *WHEN THE TYPE D-41 OR D-51 IS USED, COLOR CODING MUST BE CAREFULLY FOLLOWED ON THE K (RED), Y (YELLOW), AND Z (BLACK) LEADS, SINCE THE Y AND Z LEADS HAVE DIFFERENT VOLTAGE LEVELS. ON THE D-41 DO NOT APPLY HIPOT VOLTAGE BETWEEN K, Y AND Z TERMINALS, OR THE SOLID-STATE COMPONENTS MAY BE DAMAGED. ON THE D-51 DO NOT APPLY HIPOT VOLTAGE ABOVE 1500 VOLTS.*

For separate instructions covering wiring and installation of contact devices and impulse generators, refer to the publication list on page 14.

NOTE: *Types D-5, D-12, and D-13 contact devices used on earlier VW series meters cannot be used on VW-60 series meters.*

All meters ordered with a contact device, or for use with a contact device, have, in addition to the pinion on the rotor shaft, three contact device leads and terminals, so that either a 2-wire or 3-wire contact device can be used.

Meters of the V-60 series which were not ordered for use with a contact device have the frame bosses machined for mounting the contact device. To convert a meter which is already in service to a VW-60 series meter with contact device, it is necessary to purchase a conversion kit, in addition to the contact device itself. Refer to the Meter Handbook, Section 7782, or contact the nearest General Electric Sales Office.

NOTE: *For V-64 meters, the register drive assembly contains the necessary spur pinion.*

The drilling necessary to accommodate the contact device leads or terminals in such a conversion is accomplished as follows:

Type V-62-A meters have drill spots molded into the terminal block to facilitate drilling holes for the contact device leads, which are brought out through the bottom of the block. See Fig. 12b.

Types V-63-A, -64-A, -65-A and -66-A meters have spaces molded into the terminal block for the contact device terminals, but do require drilling through the molded barriers in the front and bottom of the block to allow clearance for the terminal set-screw and entry of the external connection lead. See Fig. 12.

All V-60 socket-type, 5-, 7-, and 8-terminal meters require that a barrier (identified by KYZ, see Fig. 4) be drilled out to open the hole through the molded base for the 3-conductor, contact-device lead cable. No drilling is necessary on 13-terminal socket-type meters.

POTENTIAL INDICATING LAMPS

Meters rated for use with instrument transformers are furnished with potential indicating lamps. These are connected to isolated secondary windings on the potential coil cores, so that they give a positive indication of the presence of potential magnetic flux in the stator core.

For Type V-60 two-stator meters, the lamps are located on the same sides as their respective stators. For Type V-64 three-stator meters, the early design had the lamps for the right-hand and rear stators located on the right side, one above the other. With this construction, the upper lamp indicated potential for the rear stator. Newer construction avoids possible confusion by placing the lamp for the rear stator near the magnetic-suspension lower guide, hence nearer the rear stator position.

DETENT

For applications in which reverse rotation of the meter must be prevented, a detent is available. The detent used on V-60 series meters is located at the lower end of the rotor shaft. The pawl support is seated upon the frame surface around the lower guide, and the ratchet is attached to the lower end of the shaft (see Fig. 11). With the ratchet seated up against the shoulder on the shaft, the pawl will have correct mesh with the ratchet and no further adjustment will be necessary.

This detent can be installed readily on any V-60 series meter. For installation instructions, refer to Instructions GEH-2763.

NOTE: *Detents used on V-series meters will not fit V-60 series meters.*

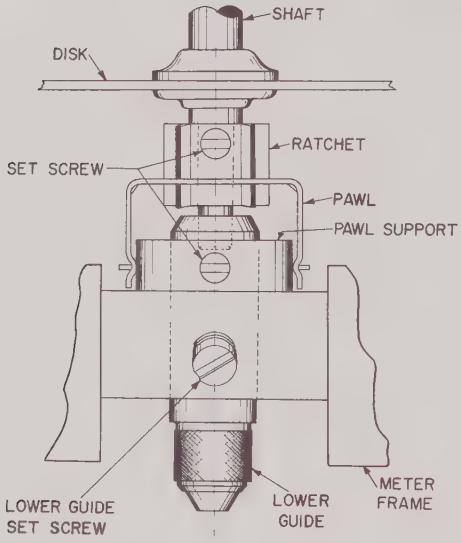


Fig. 11. Detent assembly

FORM DESIGNATIONS

The form number identifies a meter for a particular application. It identifies wiring and terminal arrangement, and also whether a meter is self-contained or transformer-rated. The number does not change with current and voltage rating or when auxiliary equipment (such as demand registers, detents, or contact devices) is used. When replacing a meter, one having the same form number and the same voltage and current rating should be used.

Listed below are the numbers shown in this book (Fig. 12 and following), "S" numbers for socket-connected meters and "A" numbers for bottom-connected meters.

MSJ-10 Form No.	Type Meters	No. Stators	No. Current Circuits	No. External Circuit Wires
5S, 5A	V-63*	2	2	3 (or 4)
6S, 6A	V-65*	2	3	4Y
7S	V-65*	2	3	4Y
8S, 8A	V-66*	2	3	4Δ
9S, 9A	V-64*	3	3	4Y
10S (alt)	V-64*	3	3	4Y
12S, 12A	V-62	2	2	3
13S, 13A	V-63	2	2	3 (or 4)
14S, 14A	V-65	2	3	4Y
15S, 15A	V-66	2	3	4Δ
16S, 16A	V-64	3	3	4Y

* Transformer-rated

LIST OF PUBLICATIONS

Instruction Books:

Type M-60 FS-2 Demand Register	GEH-2778
Type M-60 FS-1 Demand Register	GEH-2768
Type M-30 Demand Register	GEH-1529
Type M-31 Demand Register	GEH-1451
Type M-51 Demand Register	GEH-2783
Types D-20 and D-30 Contact Devices	GEH-2754
Type D-41 Impulse Generator	GEH-2767
Type D-51 Impulse Generator	GEH-2781
Installation of Detent Assembly	GEH-2763

Renewal Parts Bulletins:

V-60 Series Meters	GEF-4132
Types D-20 and D-30 Contact Devices and Type D-41 Impulse Generator	GEF-4091
Type D-51 Impulse Generator	GEF-4344

How to Test and Adjust GE Watthour Meters	GET-813
Constant and Register Ratio Data	GET-1887
How to Select Contact Devices and Impulse Generators	GET-3048
Metering Selection Guide	GET-3120

TROUBLE-SHOOTING

Trouble	Probable Cause	Remedy
Meter does not run	Loose connection	Tighten connections
	Test link(s) open	Close test links
	Dirt in disk air gap	Clean air gaps*
	Disk dragging on pole faces	Adjust disk height in air gap
	Register mesh too deep, causing jamming against rotor shaft	Adjust mesh to 1/3 to 2/3 tooth depth
	Wrong connections (stators opposing)	Connect according to applicable wiring diagram
Meter slow and/or variable on light load	Dirt in disk air gap	Clean air gaps*
	Register mesh too deep	Adjust mesh to 1/3 to 2/3 tooth depth
	Dirt in outer suspension or lower guide	Clean parts*
(with demand register)	Register driving pointer	On M-30, M-31, and M-51 registers, set pointer pusher to zero and pointer at full scale before checking calibration. On M-60 registers, be sure that the register is set in the sensing position and that the reset actuator does not reset during test.
	Demand register motor not energized	Energize motor
	Demand register motor connected with polarity reversed	Connect leads according to polarity markings
(with contact device)	Contact device drive gear meshed too deep in rotor shaft pinion	Adjust mesh to 1/3 to 2/3 tooth depth
	Calibration checked over too few disk revolutions	Light load check should cover sufficient revolutions of disk to average out variation in friction due to contact position (4 to 6 revolutions)
Meter runs at half speed	Wrong K_h being used	Use nameplate K_h to determine correct revolutions for meter under test
	One test link open (on meters with 2 or 3 test links)	Close test links

* In cleaning any part which incorporates a permanent magnet, such as the retarding magnet, outer suspension assembly, or the inner magnet at the top of the rotor shaft, it is very important that the surfaces of these magnets never come into contact with any magnetic object, as this could cause a partial loss of strength of the magnet.

TROUBLE-SHOOTING (Cont'd)

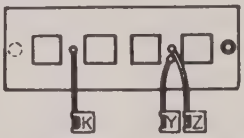
Trouble	Probable Cause	Remedy
Meter runs at half-speed (Cont'd)	One potential coil open-circuited, as shown by ohmmeter check with meter de-energized, or by lack of vibration of steel screwdriver blade held near torque balance screws with meter energized	If open-circuited winding is indicated, replace complete stator
Meter runs fast on all loads (beyond range of FL adjustment)	Retarding magnet demagnetized	Replace magnet
Meter runs backward at full load	Wrong connections	Correct connections
Meter creeps on potential only (more than on disk revolution)	Light load adjustment set too fast or too slow Voltage too high Shorted current coil turns	Adjust light load calibration Operate at not over 130 percent rated voltage If 0.5 PF calibration is outside range of PF adjustment, shorted coil is indicated. Replace stator
Meter creeps on current only (rated current)	Shorted or unbalanced current coil turns	Replace stator
Meter runs slow at 0.5 PF (beyond range of PF adjustment)	Shorted potential or current coil turns	Replace stator
Noisy meter	Insufficient vertical clearance between rotor shaft and lower guide pin Double voltage on meter	Adjust height of rotor and lower guide Operate at not over 130 percent rated voltage

TROUBLE-SHOOTING (Cont'd)

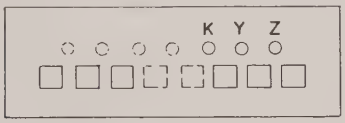
Trouble	Probable Cause	Remedy
Meter overheats	Meter overloaded	Use higher capacity meter
	Meter mounting of insufficient capacity	Install heavy-duty mounting
	Double voltage on meter	Operate at not over 130 percent rated voltage
	Shorted potential coils turns	If 0.5 PF calibration is outside slow range of PF adjustment, shorted coil is indicated. Replace stator

TERMINAL MARKINGS—BOTTOM-CONNECTED METERS

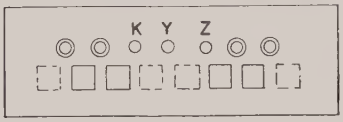
(a) Types V-62-A and VM-62-A—Form 12A, self-contained



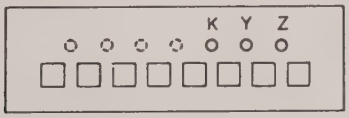
(b) Type VW-62-A—Form 12A, self-contained



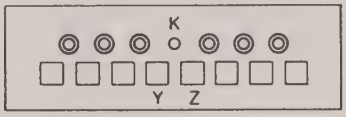
(c) Types V-63-A, VM-63-A and VW-63-A; 3-wire, 1-, 2-, or 3-phase—Form 13A, self-contained



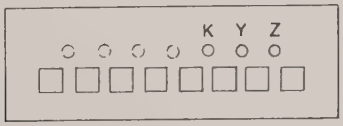
(d) Types V-63-A, VM-63-A and VW-63-A; 3-wire, 1-, 2-, or 3-phase and 4-wire, 2-phase—Form 5A, transformer-rated



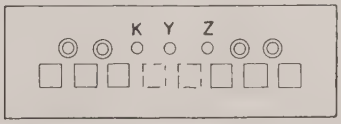
(e) Types V-64-A, VM-64-A and VW-64-A; 4-wire Y, 3-phase—Form 16A, self-contained



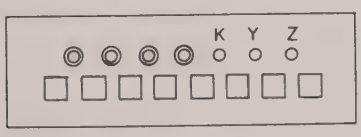
(f) Types V-64-A, VM-64-A and VW-64-A; 4-wire Y, 3-phase—Form 9A, transformer-rated



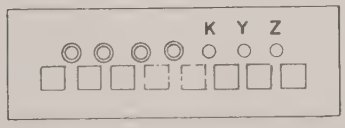
(g) Types V-65-A, VM-65-A and VW-65-A; 4-wire Y, 3-phase—Form 14A, self-contained



(h) Types V-65-A, VM-65-A and VW-65-A; 4-wire Y, 3-phase—Form 6A, transformer-rated



(i) Types V-66-A, VM-66-A and VW-66-A; 4-wire Δ, 3-phase—Form 15A, self-contained



(j) Types V-66-A, VM-66-A and VW-66-A; 4-wire △, 3-phase—Form 8A, transformer-rated

NOTES: 1. Potential terminals identified by white marking (◎)

2. On VW-60 meters only:

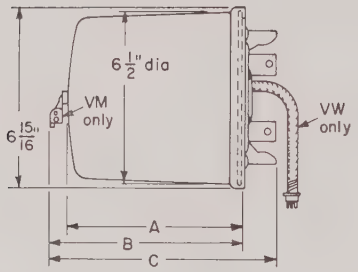
a. Terminals K, Y and Z used for 3-wire contact devices

b. Terminals K and Z used for 2-wire contact devices

c. Contact-device terminals identified by red marking

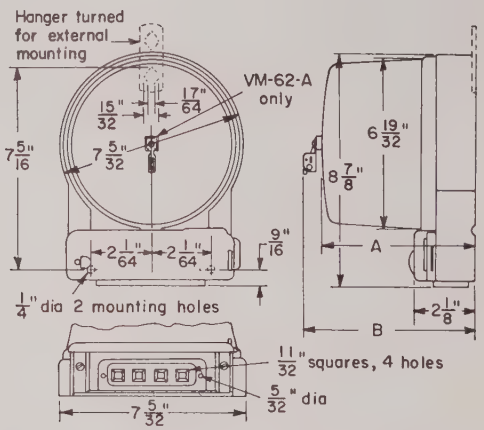
Fig. 12. Terminal arrangements and markings for bottom-connected meters

OUTLINE AND MOUNTING DIMENSIONS



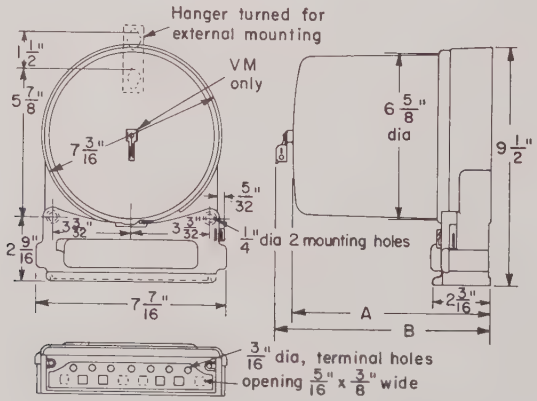
No. of Stators	Meter Types	Demand Register	Dimensions in Inches (Max)		
			A	B	C
2	V, VW	.....	5⅞	....	7¼
2	VM	M-60	8⅜	8 13/16	10 3/16
2	VM	M-30, -31, -51	7 1/16	7¾	9⅛
3	V-64, VW-64	.....	6¼	....	7⅝
3	VM-64	M-60	8¾	9 7/16	10 13/16
3	VM-64	M-30, -31, -51	7 11/16	8⅜	9¾

Fig. 13. Types V-62-S, V-63-S, V-65-S and V-66-S 2-stator meters and Type V-64-S 3-stator meters. Also for VW and VM models.



Meter Types	Demand Register	Dimensions in Inches (Max)	
		A	B
V, VW	.....	5⅞	.....
VM	M-60	8½	9 3/16
VM	M-30, -31, -51	7½	8 3/16

Fig. 14. Types V-62-A, VM-62-A and VW-62-A 2-stator meters.



No. of Stators	Meter Types	Demand Register	Dimensions in Inches (Max)	
			A	B
2	V, VW	.....	6 1/16	.....
2	VM	M-60	8¾	9⅜
2	VM	M-30, -31, -51	7¾	8⅜
3	V-64, VW-64	.....	6½	.....
3	VM-64	M-60	9 5/16	9 13/16
3	VM-64	M-30, -31, -51	8½	9 1/16

Fig. 15. Types V-63-A, V-65-A and V-66-A 2-stator meters and Type V-64-A 3-stator meters. Also VW and VM models.

EXTERNAL CONNECTION DIAGRAMS

NOTE: Dotted arrows indicate socket circuit-closing devices

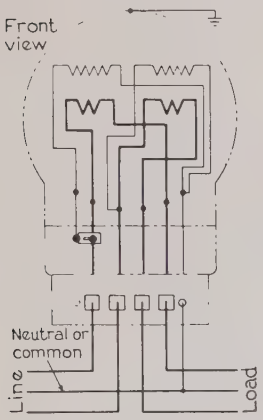


Fig. 16. *Types V-62-A and VM-62-A; 3-wire network, 1-, 2-, and 3-phase—Form 12A, self-contained.*

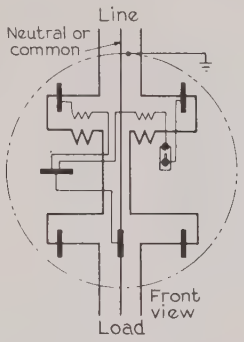


Fig. 17. *Types V-62-S and VM-62-S; 3-wire network, 1-, 2-, and 3-phase—Form 12S, self-contained.*

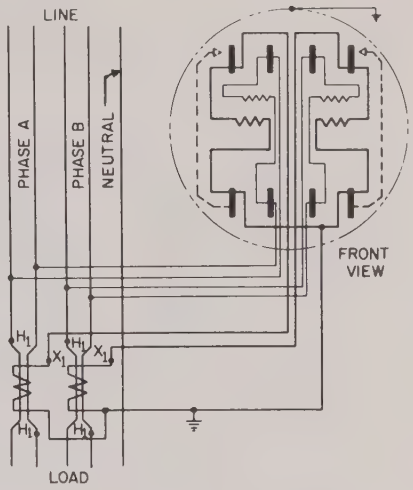
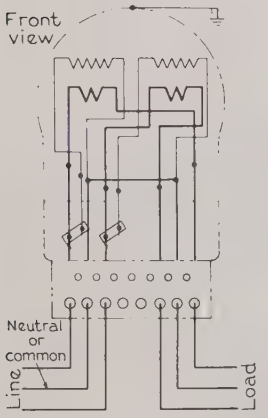
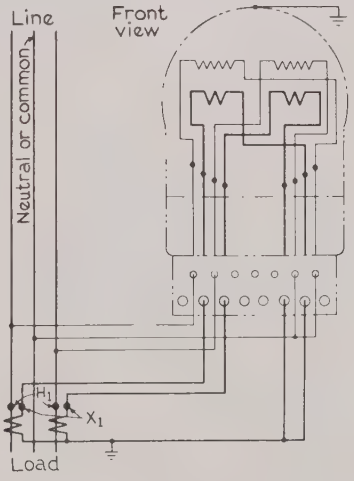


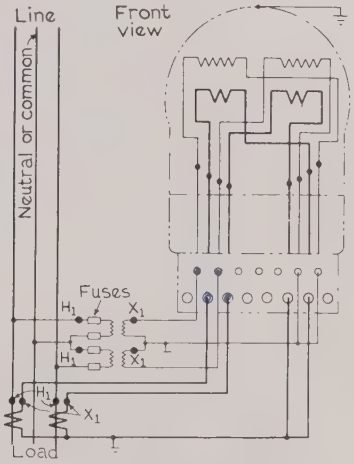
Fig. 18. *Type V-63-S meter for 5-wire, 2-phase circuits or for totalizing two 3-wire, single-phase circuits—Form 5S, with 3-wire current transformers.*



(a) Form 13A, self-contained

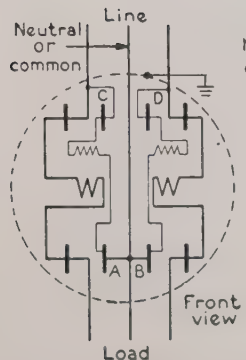


(b) Form 5A, with current transformers



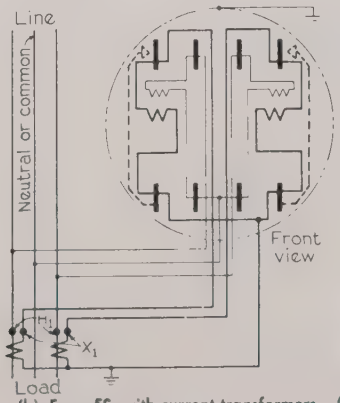
(c) Form 5A, with current and potential transformers

Fig. 19. *Types V-63-A and VM-63-A 2-stator meters for 3-wire, 1-, 2-, or 3-phase circuits*

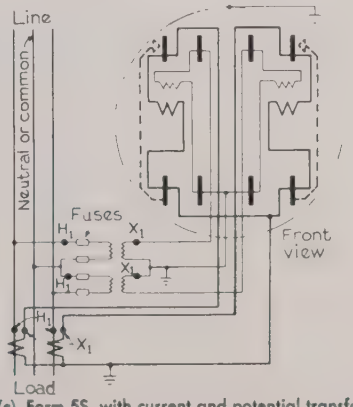


(a) Form 13S, self-contained

NOTE: Make jumper connections A, B, C and D in socket



(b) Form 5S, with current transformers

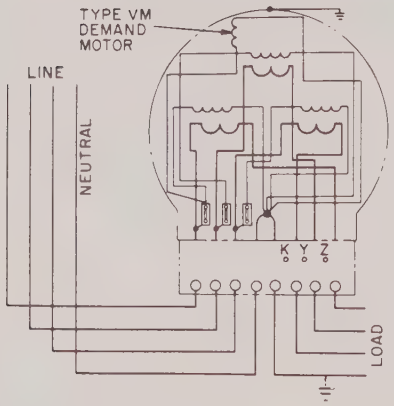


(c) Form 5S, with current and potential transformers

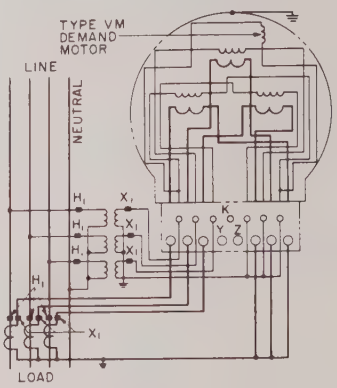
Fig. 20. *Types V-63-S and VM-63-S 2-stator meters for 3-wire, 1-, 2-, or 3-phase circuits*

EXTERNAL CONNECTION DIAGRAMS

NOTE: Dotted arrows indicate socket circuit-closing devices

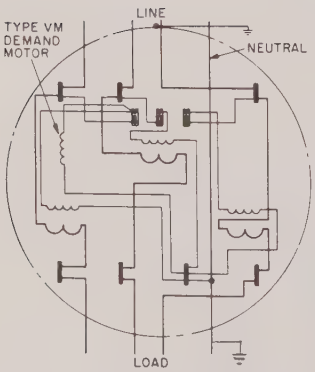


(a) Form 16A, self-contained

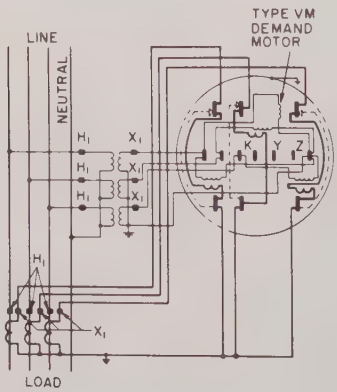


(b) Form 9A, with current and potential transformers

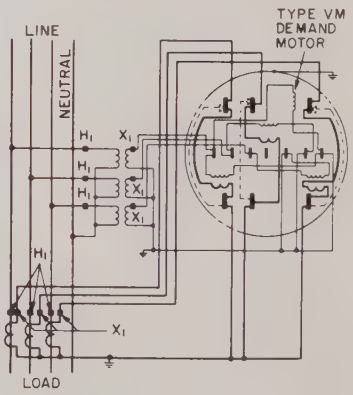
Fig. 21. Types V-64-A and VM-64-A 3-stator meters for 4-wire Y, 3-phase circuits (front views)



(a) Form 16S, self-contained



(b) Form 9S, with current and potential transformers

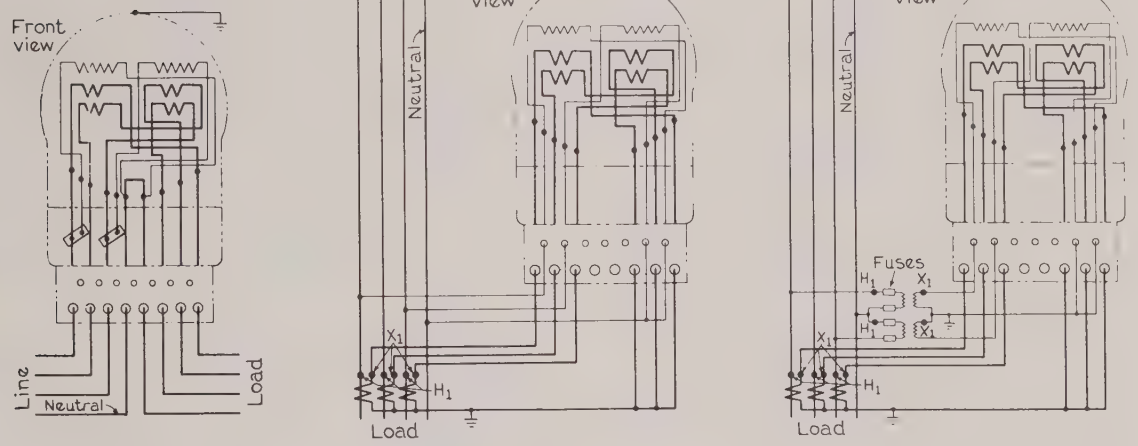


(c) Form 10S, with current and potential transformers

Fig. 22. Types V-64-S and VM-64-S 3-stator meters for 4-wire Y, 3-phase circuits (front views)

EXTERNAL CONNECTION DIAGRAMS

NOTE: Dotted arrows indicate socket circuit-closing devices

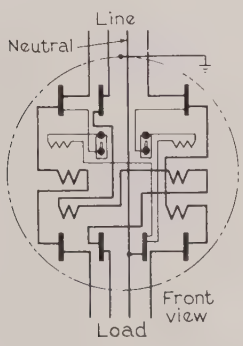


(a) Form 14A, self-contained

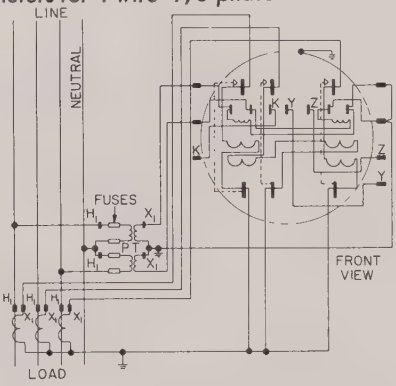
(b) Form 6A, with current transformers

(c) Form 6A, with current and potential transformers

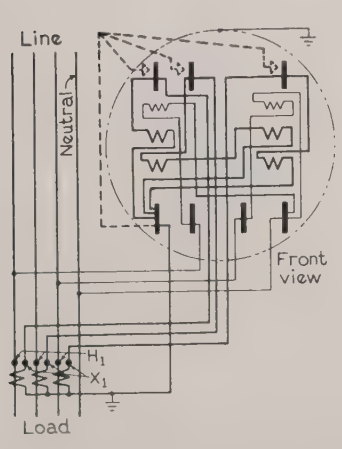
Fig. 23. Types V-65-A and VM-65-A 2-stator meters for 4-wire Y, 3-phase circuits



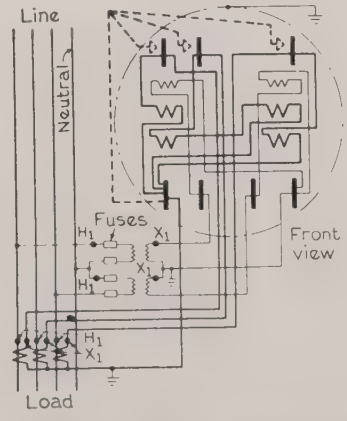
(a) Form 14S, self-contained



(b) Form 6S, 13-terminal, with current and potential transformers



(c) Form 7S, 7-terminal, with current transformers

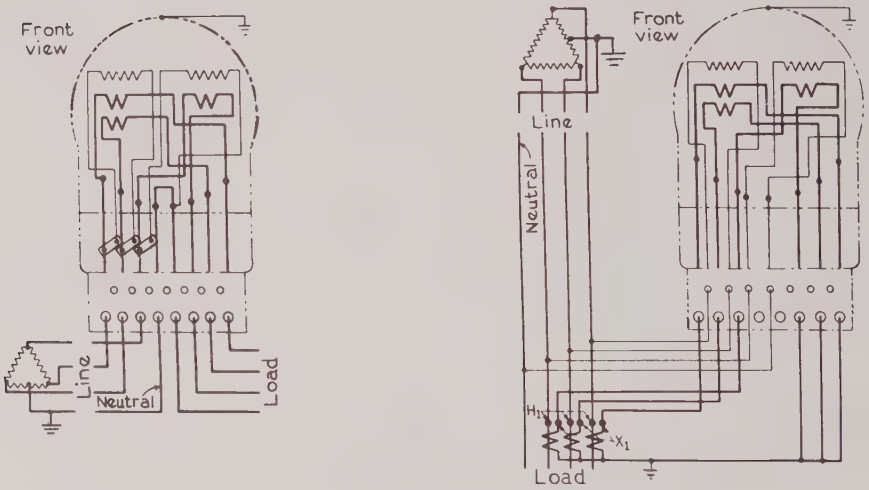


(d) Form 7S, 7-terminal, with current and potential transformers

Fig. 24. Types V-65-S and VM-65-S 2-stator meters for 4-wire Y, 3-phase circuits

EXTERNAL CONNECTION DIAGRAMS

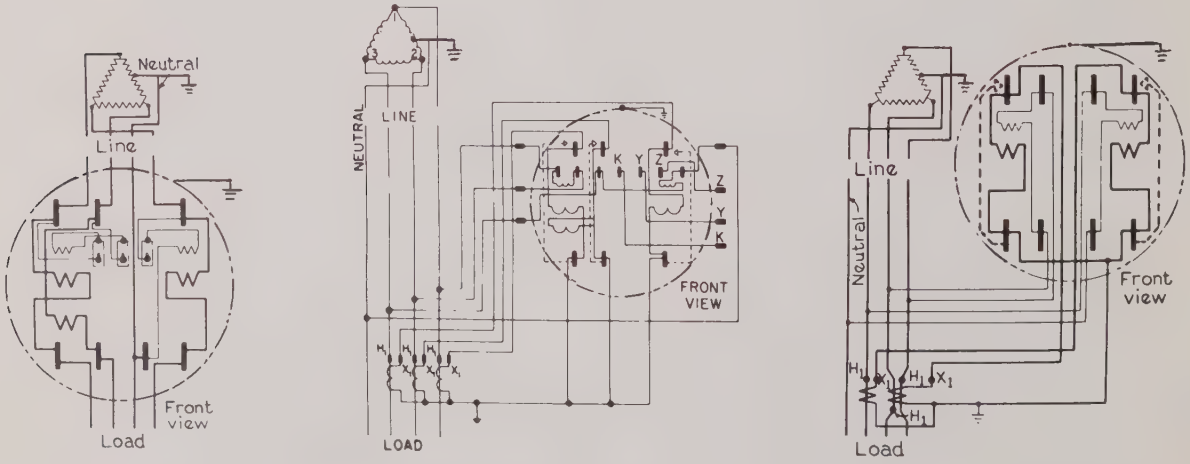
NOTE: Dotted arrows indicate socket circuit-closing devices



(a) Form 15A, self-contained

(b) Form 8A, with current transformers

Fig. 25. Types V-66-A and VM-66-A 2-stator meters for 4-wire △, 3-phase circuits



(a) Types V-66-S and VM-66-S—Form 15S, self-contained

(b) Types V-66-S and VM-66-S 13-terminal meters—Form 8S with current transformers

(c) Types V-63-S and VM-63-S 3-wire, 3-phase meters—Form 5S, with one 3-wire and one regular current transformer

Fig. 26. Types V-66-S, VM-66-S, V-63-S and VM-63-S 2-stator meters for 4-wire △, 3-phase circuits

DETENT ASSEMBLY

FOR WATTHOUR METERS WITH MAGNETIC SUSPENSION

V-60, DS-50, AND DS-60 SERIES METERS

For these meters use detent assembly Cat. No. 9688710G1. Old-style detents, for use on meters without magnetic suspension, cannot be used on these meters.

The detent, when installed on a watthour meter, prevents the rotor from turning in the reverse direction. It consists of a pawl support which fits over the lower guide, and a ratchet which mounts on the lower end of the rotor shaft. Both are held in place by setscrews.

SECTION I

For all who are familiar with assembly, disassembly, and adjustment of magnetic suspension components, only the following additional instructions need to be followed when installing a detent. For more detailed instructions, refer to SECTION II.

1. Remove the register, nameplate, retarding magnet, and rotor assembly from the meter.

2. Install the ratchet over the lower end of the rotor shaft. Seat the ratchet up against the shoulder on the lower end of the shaft, having the end with the setscrew up toward the disk (see Fig. 1). Carefully tighten the setscrew.

3. Slip the pawl support over the lower end of the rotor shaft so that the pawl teeth engage the ratchet. While holding the pawl support in this position, replace the rotor assembly in the meter.

4. Replace the retarding magnet and center the disk in the magnet air gap. Tighten the rotor assembly setscrews.

5. Remove the retarding magnet and properly position the pawl support by pushing it down against the meter frame (see Fig. 1). Tighten the pawl support setscrew.

6. Replace the retarding magnet nameplate, and register.

7. Check calibration of the meter at full load and light load. A slight adjustment at light load may be necessary to compensate for the small added friction of the detent.

SECTION II

Detailed instructions for installing the detent are as follows:

1. Remove the register.

2. Remove the nameplate and retarding magnet, being careful not to damage the disk.

3. Loosen the lower guide setscrew and remove the lower guide.

4. Loosen the upper suspension setscrew and remove the upper suspension magnet assembly.

NOTE: Necessary precautions should be observed in handling to prevent demagnetization of the magnet or damage to the guide pin. Cleanliness is essential when handling this part.

5. Remove the rotor.

NOTE: The die-cast section at the top of the shaft contains the inner magnet. Necessary precautions should be observed in handling to prevent demagnetization. Cleanliness is essential when handling this part.

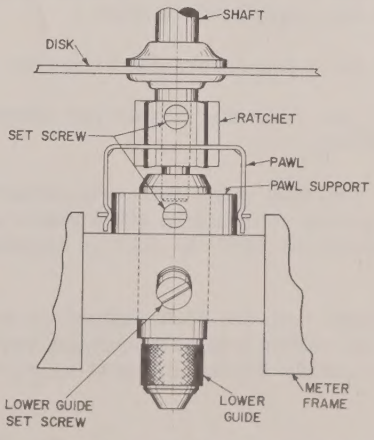


Fig. 1. Detent Assembly Cat. No. 9688710G1 (front view)

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

GENERAL ELECTRIC

6. Install the ratchet over the lower end of the rotor shaft. Seat the ratchet up against the shoulder on the lower end of the shaft, having the end with the setscrew up toward the disk (see Fig. 1). Carefully tighten the setscrew.

NOTE: Necessary precautions should be observed in handling to prevent damage to the rotor assembly.

7. Inspect the inner magnet for cleanliness.

8. Slip the pawl support assembly over the lower end of the rotor shaft, with the pawl uppermost so that its teeth engage the ratchet. While holding the pawl support assembly in this position, replace the rotor in the meter frame. To prevent friction, be sure that the pawl has some end shake.

9. Inspect the upper suspension magnet assembly for cleanliness, then insert it in the hole at the top of the meter frame and enter the top of the rotor shaft into the assembly. Entry of the guide pin into the graphite bushing is aided by the countersink in the bushing.

10. Finger tighten the upper suspension setscrew.

11. Inspect the lower guide for cleanliness.

12. Insert the lower guide in the hole at the bottom of the meter frame, entering the guide pin into the bushing at the lower end of the rotor shaft and at the same time entering the guide pin housing into the pawl support of the detent.

13. Finger tighten the lower guide setscrew.

14. Temporarily replace the retarding magnet, being careful not to damage the disk.

15. Center the disk in the retarding magnet air gap by moving the upper suspension magnet assembly. The meter should be in its normal operating position when this adjustment is made.

16. Tighten the upper suspension setscrew.

17. Remove the retarding magnet (for better access to the detent).

18. Loosen the lower guide setscrew and move the lower guide upward until motion of the disk is noted, then move downward .005" to .010". Tighten the setscrew.

19. Make sure that the pawl support is seated down against the meter frame surrounding the lower guide, then carefully tighten the pawl support setscrew.

20. Check for proper operation of the detent. The rotor should spin freely in the forward direction and be restrained in the reverse direction.

21. Replace the retarding magnet, nameplate, and register.

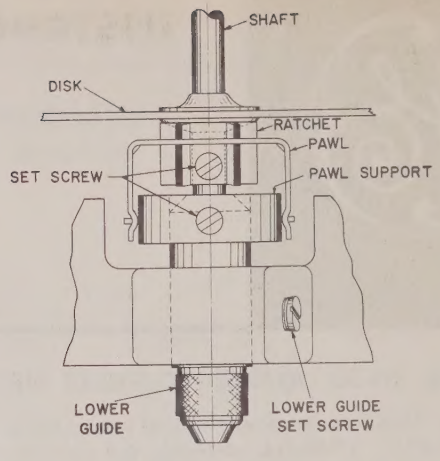


Fig. 2. Detent Assembly Cat. No. 4133755G44 (front view)

22. Check calibration of the meter at full load and light load. A slight adjustment at light load may be necessary to compensate for the small added friction of the detent.

I-50, I-55, AND I-60 METERS

For these meters use detent assembly Cat. No. 4133755G44. Old-style detents, for use on meters without magnetic suspension, cannot be used on these meters.

NOTE: The detent can only be installed upon I-50, I-55, and I-60 meters that have been adapted to include detents. This is because the die-cast frame requires a modification to accommodate the detent.

Install the detent as outlined under SECTION II above, but with the following changes:

1. Delete steps 2, 14, and 17.

2. Change step 6 to read:

   Install the ratchet over the lower end of the rotor shaft. Seat the ratchet up against the shoulder on the underside of the disk, having the countersunk end toward the disk (see Fig. 2). Carefully tighten the setscrew.

   NOTE: Necessary precautions should be observed in handling to prevent damage to the rotor assembly.

3. Change step 19 to read:

   Hold the disk down against the lower guide and move the pawl support so that the upper surface of the pawl is .065" to .080" from the underside of the disk. Carefully tighten the pawl support setscrew.

4. Change step 21 to read:

   Replace the register.

METER DEPARTMENT, GENERAL ELECTRIC COMPANY, SOMERSWORTH, N. H.

9-65 (2M)

NOTES

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A I S U	Memphis 38116	3385 Airways Blvd.
A	Murfreesboro 37130	117 N. W. Broad St.
A U	Nashville 37203	1717 West End Bldg.
C	Nashville 37204	2930 Sidco Drive
M	Oak Ridge 37830	253 Main St., East

TEXAS

S U	Abilene 79601	442 Cedar St.
S U	Amarillo 79101	303 Polk St.
A I S U	Beaumont 77704	1385 Calder Ave.
S U	Corpus Christi 78401	205 N. Chaparral St.
A C I S U	Dallas 75247	8101 Stemmons Freeway
I S U	El Paso 79902	215 N. Stanton St.
A	El Paso 79902	2800 N. Stanton St.
A	Fort Worth 76107	100 N. Univ. Dr.
S U	Fort Worth 76102	408 W. 7th St.
A C I S U	Houston 77027	4219 Richmond Ave.
A I	Lubbock 79408	500 E. 50th St.
A S	Midland 79704	122 N. "N" St.
A S U	San Antonio 78204	419 S. Main Ave.

UTAH

A I S U	Salt Lake City 84110	431 S. Third E St.

VERMONT

U	Rutland 05702	38 1/2 Center St.

VIRGINIA

A M S	Newport News 23801	311 Main St.
A I S U	Richmond 23230	1508 Willow Lawn Dr.
A I S U	Roanoke 24015	2018 Colonial Ave., SW

WASHINGTON

A I M S U	Seattle 98188	112 Andover Park, E.
A I S U	Spokane 99220	E. 1805 Trent Ave.

WEST VIRGINIA

A I S	Charleston 25328	306 MacCorkle Ave., SE
I U	Fairmont 26555	310 Jacobs Bldg.
A	Huntington 25701	Sixth Ave. & Ninth St.
I	Wheeling 26002	40 14th St.

WISCONSIN

A I S U	Appleton 54911	3003 W. College Ave.
U	Madison 53704	2038 Pennsylvania Ave.
C	Milwaukee 53226	Mayfair Plaza, 2421 N. Mayfair Rd.
A I S U	Milwaukee 53202	615 E. Michigan St.

CANADA

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